37 8

Preliminary Investigations on Using Ion-Exchange Membranes for Multi-Elemental Analysis of Coastal Organic Soils

L.C. Dharmasri and W.H. Hudnall

Agronomy Department, LSU Agricultural Center
Louisiana State University, Baton Rouge,
LA 70803, USA

ABSTRACT. *Potential of using resin strips for multi-elemental analysis of wetland soils, especially in coastal wetlands, needs to be investigated because of the high soluble salt concentrations present in coastal organic soils. Soil and water samples were collected within brackish and saline marsh areas of the Barataria Bay Basin, Louisiana, USA. Anion- and cation-exchange resin membranes were cut into 10×40 mm strips and used with soil-water suspensions and water samples. Cationic resins were eluted with 25 ml of 0.5 M HCl. The performance of 0.5 M HCl and 0.5 M NaHCO₃ was compared for the anionic resins. For coastal organic soils, over night (16 h) shaking was the optimum shaking time and three hours (3 h) was adequate for elution. The 0.5 M HCl can preferably be used for elution of both resins. Major cations and sulphate were well predicted from resin extractions. Inclusion of electrical conductivity (EC) into the regression equations improved R^2. Addition of EC as a second variable increased the R^2 considerably for divalent ions. Use of soil:water suspensions of 1:10, diluted the salinity effect, thus EC could be excluded from prediction equations. This procedure is proposed as an alternative to the traditional analytical methods. Prediction models presented in this paper are recommended for the Barataria Bay Basin water system and similar estuarine systems.*

INTRODUCTION

Ion-exchange resin strips can be used for soil testing since they give a quick assessment of elemental concentrations within the soil (Lee and Zeng, 1993; McLaughlin *et al.*, 1993). Performance of resins for wetland soils, especially in coastal wetlands, needs to be investigated because of the high soluble salt concentrations present in coastal organic soils. Ionic competition due to high salinity may limit the affinity of target ions onto resins (Amer *et al.*,

1955), and this potential limitation must be identified before using resins in these soils. In this study, resin strips were tested for multi-elemental analysis of coastal organic soils and estuarine water.

MATERIALS AND METHODS

Anion- and cation-exchange resin membranes were cut into 10×40 mm strips. Soil and water samples were collected within brackish and saline marsh areas of the Barataria Bay Basin, Louisiana, USA. Soil:water suspensions (5 ml scoop of soil in 50 ml of water) and filtered water samples were used with resins. In two separate experiments, time periods ranging from 1 to 24 h were tested to determine the optimum time for shaking with resins and for elution. For soil and water analysis, a measured volume of 50 ml of water samples and soil suspensions were shaken with resin strips for 16 h. The strips were rinsed with de-ionized water and transferred into the eluent and shaken for 24 h. Cationic resins were eluted with 25 ml of 0.5 M HCl. The $NaHCO_3$ eluent interferes with low sulfur detection by Inductively Coupled Plasma (ICP-AES), therefore performance of 0.5 M HCl and 0.5 M $NaHCO_3$ were compared for the anionic resins. The resin strips were removed and the eluent was analyzed by ICP-AES for resin extracted elements. Water samples and water soluble elements of soils were also analyzed by ICP-AES.

RESULTS AND DISCUSSION

For coastal organic soils, over night (16 h) shaking was the optimum shaking time and three hours (3 h) was adequate for elution. Major cations (Ca, Mg, Na and K) and chloride and sulphate anion concentrations were highly related to the electrical conductivity (EC) of the water and soil samples. Proportions of the major cations were constant within the EC range of the water samples (6 to 48 dS/m). The EC of the soil suspensions ranged between 2 and 4 dS/m. Mean comparison indicated no significant difference between eluents; therefore 0.5 M HCl can preferably be used for elution of anionic resins. Major cations and sulphate were well predicted by resin extractions. Inclusion of EC into the regression equations improved R^2. Addition of EC as a second variable increased the R^2 considerably for the divalent ions Mg, Ca and Sr. The regression models emphasize the role of EC in predicting elements using resin extractions in high saline conditions. Using soil:water suspensions of 1:10,

diluted the salinity effect that limits the affinity of target ions on to resin. For example, water soluble sulphate was well predicted from resin extractions alone ($R^2 = 0.95$) for soil suspensions.

CONCLUSIONS

Resin extractable elements can predict the cation and anion concentrations in soil and water samples. Both resin types can be used together with 0.5 M HCl as the eluent if ICP-AES is used for elemental analysis. This procedure is proposed as an alternative to the traditional analytical methods. Prediction models presented in this paper are recommended for the Barataria Bay Basin water system and similar estuarine systems.

ACKNOWLEDGEMENTS

REFERENCES

Amer, F., Bouldin, D.R., Black, C.A. and Duke, F.R. (1955). Characterization of soil phosphorus by anion exchange resin adsorption and P32-equilibration. Plant and Soil. 6: 391-408.

Lee, D. and Zeng, H. (1993). Chelating resin membrane method for estimation of soil cadmium phytoavailability. Commun. Soil Sci. Plant Anal. 24: 685-700.

McLaughlin, M.J., Lancaster, P.A., Salin, P.W.G., Uren, N.C. and Peverill, K. I. (1993). Use of cation/anion exchange membranes for multi-element testing of acidic soils. Plant and Soil. 155/156: 223-226.